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ABSTRACT

One of four reports designed to assess the current state of new technologies, the document reviews the present and future 5-year status of telecommunication technologies in regular and special education. Briefly described are technological and economic aspects of videotex/teletext, subscription services, satellite broadcasting, cable television, and teleconferencing including video-, audio-, and computer conferencing. General educational use of telecommunications is described relative to current trials and future use of videotex/teletext, and eight other forms of telecommunications including SpecialNet, and Silent Network (a cable satellite group for the deaf), and major network programing for the deaf. Factors discussed as affecting use of telecommunications technologies within the next five years are hardware advances, software developments, and capabilities of local schools. The summary states that technologies are changing rapidly due to technology breakthroughs, standardization, and deregulation, and that within the next five years substantial expansion of educational use of television and subscription services can be expected, along with experimentation among the other technologies. (MC)

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TELECOMMUNICATIONS IN SPECIAL EDUCATION

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Preface

This document is one of four reports designed to assess the current state of new technologies, review the current uses of the technologies in regular and special education, and project the manner in which these technologies will affect special education during the next five years. These reports address four very important categories of new technology: microcomputers, telecommunications, videodiscs, and communication aids.

The information presented in this report is the result of the distillation of a great deal of data from a wide variety of information sources. Foremost among these sources were:

- discussions with high-level officials from more than 60 firms which develop, produce, publish, or distribute technology hardware and software;
- responses of nearly 200 high-level LEA special education officials who attended four project technology workshops;
- information reported by such education and industry organizations as TALMIS, Knowledge Industry Publications, the National Audio Visual Association (Materials Council), the National Association of State Directors of Special Education, the TRACE Center, and the Society for Applied Learning Technology;
- Federal reports sponsored by the National Science Foundation, the National Center for Education Statistics, the Office of Technology Assessment, ED/Division of Education Technology, and ED/Special Education Programs (SEP); and
- independent research studies and surveys.

In addition to these project sources, Education TURNKEY Systems staff has conducted workshops on technology applications in special eduction for more than 4,500 state and local special education administrators.

The trends, estimates, and projections contained in this report have been derived from many sources and represent the best estimates of Education TURNKEY Systems and The Futures Group.

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TELECOMMUNICATIONS IN SPECIAL EDUCATION

Television has been used as an education medium for decades; only in recent years, however, have more sophisticated telecommunications techniques become available and economically feasible. These techniques hold great promise for improving education. This document describes the various telecommunications technologies and discusses the potential applications of telecommunications in regular and special education now and for the next five years.

I. THE TECHNOLOGY

Traditional communications networks are facing radical alteration. New competitors have entered recently deregulated markets, and new means for transmitting, storing, and presenting information are being invented and improved at an increasing rate. While these separate technologies are impressive, their final impact in education will be a result of their combination into totally new systems. Some communications technologies, such as cable television, have seen significant commercial progress in this country already. Others, such as videotex, are still largely at the experimental stage, at least domestically. Still others -- such as direct broadcast satellite transmission -- are an amalgam of commercial uses and experimental potential. These disparate technologies share some common characteristics: (a) all are receiving significantly increased attention from the private sector; (b) all stand to benefit from the concurrent interest and rapid development of microprocessors; and (c) all of these communications forms have barely begun to address their educational potential.

A. VIDEOTEX/TELETEXT

Videotex is the general term referring to information systems supplying text and pictures through interactive use of an adapted television or computer terminal. The primary difference between videotex and teletext is the number of directions in which information flows; teletext consists of one-way

communication (from the broadcasting station to the receiver), whereas videotex is two-way (allowing the viewer to interact with the system through a terminal or microcomputer). Several systems and standards have been developed in other countries, including England's Prestel, France's Antiope, and Canada's Telidon. A number of experiments currently exist in the United States based on these different technical standards; it is likely that within the next three years an American standard will emerge. It will probably be based on the networks developed by Canada and AT&T.

A number of information-oriented U. S. companies -- newspapers, credit card companies, broadcasters, and cable companies -- have entered into trial experiments, often in cooperation with Europeans or based on European technology. Unlike the national networks in many European countries, videotex systems in the United States cover only a small portion of the country. However, in terms of total numbers of users, the U. S. market -- even in its fragmented condition -- exceeds that of most other countries. As of January 1981, there were 40,000 teletext users, more than 14,000 interactive videotex users, and by the end of that same year more than 40,000 decoders for captioning services for the deaf had been sold. As cable networks consolidate their holdings and realize the potential of their hardware, and as telephone companies search for new ways to meet the cable competition, the size and impact of educational experiments in this country will increase.

In a recent (April 1983) decision, the FCC has allowed the distribution of data through the FM subcarrier channels of the 250 National Public Radio networks. This could allow for low-cost one-way (like teletext) transmission of electronic mail and microcomputer courseware.

B. SUBSCRIPTION SERVICES

The information supplied by videotex and teletext systems comes from centralized computer data banks. These banks, called subscription data bases or services, allow interested subscribers to have access to large amounts of information for certain preset fees and hourly access charges.

Data banks are already a highly valued resource for many U. S. businesses today. The convenience and huge amounts of readily accessible information they represent are beginning to make their appearance on the at-home consumer market, as well, and in a recent emphasis on educational offerings. More than three-fourths of the industry's revenues are derived from services which give the subscriber direct access to source material such as census data, market research studies, or legal literature. This material is aimed at businessmen, economists, financial analysts, and lawyers.

Another branch of the industry provides bibliographic or reference data bases. These are lists which tell a subscriber where to find the desired information, but do not take him or her directly to the source. These banks contain lists of books, directories of individuals and organizations, and the like.

Data base services are widening their focus to attract individual users as well as businesses. Two of the best known existing commercial data base services, The SOURCE and MicroNet/CompuServe, offer general news retrieval, stock prices, airline schedules, financial planning, electronic mail, classified ads, games, educational practice tests, and mainframe computer power. The costs of these networks include an initial charge and hourly connect time charges.

C. SATELLITE BROADCASTING

Reception and transmission of radio signals between orbiting satellites and earth stations is becoming an integral link in the domestic and international communications infrastructure. There are currently 12 satellites serving North America, offering differing programming/services. Operators of ground stations must choose between cheaper, stationary antenna dishes fixed upon one satellite and a more expensive movable receiving antenna dishes that are able to change focus to one of several different satellites.

The wide bandwidth of satellite transmissions allows integrated communications capabilities and high data transmission rates to accommodate

today's burgeoning information flows; unlike ground networks, satellite transmission costs are insensitive to distance; capacity may be relatively easily reallocated to accommodate changing needs; and finally, satellites often allow organizations greater flexibility in adapting their communications network to their unique needs.

While earth stations (i.e., ground receiving stations) have historically represented a substantial investment, this situation is changing rapidly. Higher power satellite transponders (literally, "transmit/responders") are permitting receiving antenna dishes of sizes as small as three feet in diameter. To reduce costs further, many market participants are exploring the possibility of "shared" satellite access. Cable companies are discovering satellites to be a crucial link in their information networks. In a recent move, the FCC granted licenses to seven companies to begin direct satellite-to-home transmission using high frequency signals and small inexpensive dish antennas which will further challenge established transmission modes.

D. CABLE TELEVISION

By 1982, 29 percent of U. S. television households had cable TV. Cable TV has developed two-way systems that can carry information out of the home as well as into it, breaking the previous monopoly of the telephone system in two-way telecommunications.

With the advent of satellites, cable programmers can send programming cost-effectively to cable networks located across the country. In addition to satellites, technological breakthroughs such as fiber optics are permitting greater capacity with the potential of lower cost. Significant for education is the fact that cable has proved itself to be something more than just a TV distribution network. Cable's two-way capability is the reason for its incorporation in many of the videotex experiments in the United States (such as the well known QUBE system in Columbus, Ohio). In the near future, users will have their choice of cable or telephone-based networks.

E. TELECONFERENCING

Teleconferencing consists of electronic communications among three or more persons at a number of separate locations. Three forms of teleconferencing are generally recognized: (1) video conferencing, which involves video interconnection between two or more remotely situated conference rooms via microwave, cable, or satellite; (2) audio conferencing, which is similar to the first format except that no cameras are used (some form of graphics capability, such as facsimile, is usually included); and (3) computer conferencing, in which the input device is a terminal keyboard and the output is either a printer or a cathode ray tube. Using this format of teleconferencing, no picture or voice interaction occurs, and the computer acts as an interim message storage medium.

The first satellite dedicated to an entire satellite business communications network was launched by Satellite Business Systems (SBS) in 1980, a joint venture of International Business Machines, COMSAT General, and The Aetna Insurance Company. Other organizations have developed new video teleconferencing systems as well, with the emphasis currently being placed on systems incorporating regional centers for conferencing, rather than individual telephone unit video capabilities. Bell has abandoned its original Picturephone concept in favor of the new "Picture Phone Meeting Service" which offers video conferencing in cities across the United States. These centers will feature full moving video, voice-activated service, and limited transmission of graphics.

The new teleconferencing systems focus primarily on video teleconferencing because video most nearly simulates an actual face-to-face conference. Yet it is also the most expensive. This cost differential has stimulated technical innovation in such other areas as audio teleconferencing. Audio conferencing allows immediate voice communications at a relatively low cost but lacks personal interaction and spontaneity if written material or graphics need be involved.

II. GENERAL EDUCATION USE

While videotex, cable, and satellite transmission offer obvious possibilities in the educational arena, it is only recently that major corporations have broadened their perspective to include markets other than the home consumer. A recognition is developing in private sector management that education, in both methods and participants, faces radical change in the coming years. It is also recognized that methods of learning with the new interactive systems will not become widespread unless they are cost-effective.

Suppliers are developing a three-pronged marketing strategy as they approach the educational market; this strategy consists of:

- Market Segmentation: Suppliers are analyzing the educational market to assess its structure and to identify those contacts towards whom they should direct their sales information. Some organizations consider the school district to be the logical unit and approach the market at that level, according to district size. Others focus on individual principals, superintendents, or directors of special education.

- Direct Marketing: To make educational professionals aware of telecommunications breakthroughs, some suppliers are conducting free regional seminars and sending out invitations to the individuals selected as prime contacts in the market segmentation analysis.

- Appropriate Product Development: Suppliers are attempting to increase sales through the creation of products (e.g., interactive videodiscs) which dovetail with current course materials or procedures and provide close supplemental support. In addition, suppliers are increasingly stressing the efficiency or savings-producing attributes of systems and equipment which might present an intimidating initial price tag.

Although cable programming has focused primarily on entertainment and the arts, programmers are showing increased interest in the possibility of "telecourses"; that is, educational programs structured as stand-alone material or offered in conjunction with written materials. Textbook publishers and TV producers are experimenting with telecourses to be offered in conjunction with educational institutions on a credit basis. These programs might be offered over the broadcast media or on dedicated cable channels.

Of the approximately 5,000 local cable systems in America today, less than half have channels set aside for public use. In only about half of these cases are public schools using the cable. In the 1,000 or so communities where LEAs are using cable capabilities, the vast majority of programming consists of sporting events or school board meetings. Very little instruction or staff training is being conducted using cable television.

Although still not common, the use of teleconferencing is increasing in both instructional and teacher training areas. Using various mechanisms, school districts (particularly small ones) in many states (e.g., Minnesota, Virginia) have combined resources to provide, through telecommunications, courses that individual school districts could not afford. Similarly, teacher training institutions in a number of states (e.g., Oregon, West Virginia) have used teleconferencing to expand geographically the scope of their programs.

The next five years will likely see substantial expansion of cable television (because of the greater number of communities with access to such facilities) and of subscription services (as a result of the prevalence of microcomputers) in education. Particularly in teacher training areas, the use of teleconferencing may expand in the near future as video transmission costs decline. Although the lowering costs of receiving antennae and general direct broadcast activity will result in more satellite transmission in general, it is unlikely that, five years hence, schools will be making substantial use of satellites. It is also unlikely that videotex will become an integral part of education in the next five years.

Unlike the microcomputer technology family, where almost 50 percent of the school districts have at least one hardware system, no public school district presently utilizes all of the components of telecommunications. Many districts have certain components of a telecommunications system (e.g., microcomputers, TV monitors, cable connections) but these are not yet integrated into total telecommunications networks. While the cost of telecommunications technology will continue to decrease and systems will become more efficient, it is likely that large-scale networking in public schools will evolve slowly because of the many preconditions for effective use and differing types of problems confronting LEAs.

III. TELECOMMUNICATIONS USE IN SPECIAL EDUCATION

Videotex/teletext will become more feasible and prevalent in special education applications of microcomputers. Like a computer, a videotex terminal manipulates information through use of a keyboard. While presenting no difficulties when used in an administrative support application, keyboard manipulation is often difficult for a handicapped student attempting to use the system for direct educational purposes. The barrier must be overcome, as videotex/teletext programming is focused as much on educational information as it is on administrative support activities.

For students without specific motor coordination difficulties, videotex/teletext offers several advantages:

- It is a system with a growing data base of subjects and information, an obvious benefit to any sighted person. For individuals with slightly impaired vision, large amounts of currently available videotex information are being converted to large, easily read typeface. Experiments are being conducted with voice synthesized videotex output and dynamic Braille output as well.

- It is an interactive system, allowing individualized learning and test taking. Several experiments in U. S. schools are incorporating videotex exercises as a supplement to in-school instructional television programs and are using the system for a series of interactive learning quizzes.

- It functions through a standard television set, a piece of equipment readily available in most schools. Attachment of a broadcast signal decoder and a keyboard is generally all that is required.

- It permits access to high quality national programming. At least two of the major broadcasting networks plan to have broadcast teletext programs running within the next several years. Educational segments are being considered.

Although much of the development effort in the 20-odd videotex trials are commercially oriented and focused on the home computer, some progress has been made in adapting videotex, satellites, subscription services, and cable networks into systems to meet the needs of handicapped populations. These include the following:

- SpecialNet: Designed specifically for SEA and LEA directors of special education, SpecialNet is operated by the National Association of State Directors of Special Education (NASDSE) and utilizes the GTE Telenet communications system. At present, more than 15 electronic mailboxes/bulletin boards operate on SpecialNet. The most widely used bulletin board is the NASDSE-sponsored "Federal", which monitors Federal-level activities such as Congressional actions, regulatory changes, amendments to P.L. 94-142, and other activities and events which are of high concern to the special education community. Two electronic bulletin boards (TURNKEY's "TechMark" and JWK International's "EduTech") are operated through SEP-funded projects and provide current information on computer and related technology applications in special education.

- A cable satellite group known as The Silent Network was recently launched to bring entertainment, information, and education programming to the national deaf community. Scheduling, still in its initial stages, calls for 15 hours of weekly programming; all programming will be presented in both voice and sign language. The signers will be an integral part of every production, not relegated to corner insets on the screen. Nontheatrical programming is also being explored, similar to the NBC series "Say It with Sign", which teaches American Sign Language over a 40-part series of half-hour shows. Other educational series are in the offing.

- Major networks such as NBC, ABC, and PBS are participating in closed captioning programs pioneered by SEP; CBS has opted to continue experimenting with teletext as their communications medium for the deaf.

- Funded by ED/SEP, the Deaf Communications Institute is planning a national electronic mail program for the deaf entitled "DeafNet". Through input with a home terminal, a user may exchange information with anyone else tied into the system and leave messages in "electronic mailboxes". Currently operating via home computer and telephone interface, such a system would be equally viable on emerging cable networks across the country.

- CenTex, founded in 1973 in Southeastern Virginia, is a network structure formed to explore the educational potential of television. Funded by Federal, state, and private sources, CenTex uses a variety of transmission media, including over-the-air cable and FM subcarrier broadcasting to deliver programming for student instruction and teacher training.

- AT&T is examining the potential use of its VISTA network by the handicapped. This teletext-like network has a number of terminals on field trial already; Bell will assign several more to specific handicapped groups.

- Telemachus is a data base providing 350 active pages on all aspects of disability such as services offered, benefits, and new kinds of

equipment for the handicapped in Great Britain. In addition, Telemachus designs, maintains, and operates control systems for disabled persons, and is interested in the possibilities of their being able to access information using a VDU and a simple keyboard. By early 1981, the number of accesses to the data base averaged 500 per month, but it was not possible to determine how many of the 9,000 Prestel sets were actually serving disabled persons directly.

- Services for the Deaf is a group service both through the conventional screen display of news, advise, and feedback and through subtitled programs, in some cases using the Palantype shorthand system, on Britain's Prestel network.

Of all the subscription services serving the special education community, SpecialNet, with more than 1,000 subscribers, appears to be the most comprehensive. Currently, more than 700 LEAs are tied into SpecialNet. In several states, all LEAs are linked to the system and the SEAs use SpecialNet in lieu of traditional means of communication with its LEAs. SpecialNet estimates that, in the next five years, more than 5,000 LEAs will participate in the system.

IV. FACTORS AFFECTING USE

If telecommunications technologies are to become widely used mechanisms for education and special education, certain activities will have to occur at both LEA and and industry levels. These conditions may be classified into three general areas: hardware advances, software developments, and LEA capabilities.

A. HARDWARE ADVANCES

As the electronics revolution has progressed, telecommunications technologies have played a greater and greater role in every American's life. A number of hardware related factors are expected to play an important part in LEA adoption of telecommunications technology during the coming years.

The availability of more satellite transponder space -- because of the increase in the numbers of satellites and the more efficient use of existing

transponder space -- and the potential for direct satellite broadcasts hold promise for much greater educational use of videotex and telecourses.

The proliferation of cable television systems in communities across the United States will make available to LEAs valuable educational resources. Many local cable systems have the built-in capacity for educational use of channels set aside for public use.

The costs of devices by which telecommunications can be brought into homes and schools will continue to decrease for the next few years. Small low-cost receiving antennas will make satellite less costly and cumbersome. The existence of greater numbers of microcomputers will enhance education's capacity to use subscription services and data telecommunications.

B. SOFTWARE DEVELOPMENTS

The term "software", as it applies to telecommunications, generally refers to video or data programming. As videotex standards become established and more videotex information systems are implemented, LEAs may be able to utilize the two-way capabilities of videotex for instructional purposes as an information resource.

It may be expected that, in the next five years, more efficient educational use will be made of cable television. Specifically, greater emphasis will be placed on developing instructional programming for homebound students and as a supplement to regular in-school programs. Greater use of cable television will occur as teacher in-service modules are developed for presentation on cable channels.

In the next five years it is likely that teachers colleges will make greater use of telecommunications programming as they train future teachers. Through these institutions, teachers will develop a greater awareness of the capabilities of telecommunications. These colleges are also likely to develop teacher-training courses which are designed for video presentation and which may be taped for use in local teacher training activities.

C. LEA CAPABILITIES

The degree to which LEA capabilities can be enhanced will greatly influence the adoption and effective use of telecommunications in special education.

1. Technology Orientation/Commitment: It is of primary importance that LEA staff be made familiar with telecommunications technologies and develop a general commitment to effective use of such technologies. Specifically, LEA officials should:

- develop an understanding of the potential applications and benefits of telecommunications;
- identify priority areas in which telecommunications technologies can be of greatest benefit;
- obtain resources for equipment purchases and for programming and service purchases;
- accept minor modification of facilities at the classroom or building level to accommodate specific equipment needs (e.g., receiving antennas); and
- commit the LEA to integrate telecommunications program material into existing curricula for both student restriction and teacher training.

2. Training: As with other technologies, LEA staff (particularly teachers) must be trained, beyond orientation, in the specific applications of telecommunications technology in special education. Teachers and administrators will require training in the use of various telecommunications systems, their operational advantages and constraints, and how they may be most effectively integrated into ongoing programs.

Interestingly, the technology itself offers opportunities for the delivery of such training. Teleconferencing satellite transmission and cable television can potentially serve as both the subject and medium of such training.

3. Planning and Administration: In order to accommodate telecommunications technologies in special education, LEA planning and administrative procedures should, in many cases, be modified. School officials should identify needs which can be effectively met through telecommunications and select the appropriate telecommunications mechanisms to meet these needs. Some guidance in these planning areas may be obtained from SEAs or state universities.

In order for LEA staff to become equipped to utilize telecommunications in their education programs, a number of changes in administrative structures should occur. Specifically, these could include:

- development of suitable acquisition procedures for both equipment and services;
- scheduled staff time allocations for in-service training in telecommunications usage; and
- development of procedures to prevent unauthorized use of equipment and service (particularly telephone lines).

V. SUMMARY

All of the various telecommunications technologies are in the midst of rapid change and are also becoming an increasingly common means of communicating within our society. Cable penetration in the U. S. market grew by 20 percent from 1981 to 1982. Satellites are doubling in capacity, yet competition for transponder space continues. Clearly, the technologies discussed here are experiencing unprecedented growth. The reasons for this growth are threefold:

- Technology breakthroughs in memory capacities and information transmission methods have combined to reduce drastically the cost of providing telecommunications services. Lower costs and increased efficiency in each of the technology areas permits experimentation with hybrid systems resulting in further cost savings. New software programs, increasingly able to incorporate sophisticated elements of "human" judgment and expertise, allow interaction with greater numbers of society's members, regardless of training, physical, or mental limitations.

- Standardization in both computers and videotex equipment is now occurring. Market growth has been slow because buyers feared that whatever system they purchased might be incompatible with a national standard once it developed. The broad outlines of these standards are now emerging, encouraging equipment purchases and further reducing costs through resulting mass production.

- Deregulation has shifted government away from market intervention, as highlighted by the recent AT&T settlement with the Justice Department. Accelerated introduction of new equipment and services is one likely result. Legislation is under consideration which would update the Communications Act of 1934 under which the telecommunications industry is still laboring. In addition, the FCC is responding to pressure for increased satellite space by proposing to double the number of satellites serving the U. S.; the FCC may even allow corporations to build and sell capacity on their own satellites according to market price pressures.

While these factors will continue to push telecommunications growth, it is not clear that lower costs will result in all areas. Satellite transmission, in particular, may experience increased costs as transmission demand outstrips available capacity.

During the next five years, substantial expansion of the educational use of cable television and subscription services (such as SpecialNet) can be expected. Although more experiments will occur and more general use will be made of videotex, direct satellite broadcasting, and teleconferencing, these telecommunications techniques are unlikely to have a significant effect on education or special education during the next five years.